

SECTION 15185 HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following categories of hydronic pumps for hydronic systems:
 - 1. In-line pumps.
 - 2. End-suction pumps (Base mounted Centrifugal)
 - 3. Double-suction pumps (Base mounted Centrifugal)
 - 4. Hydronic Specialties (Suction-Diffuser, Triple-duty valve, Balancing valve).
- B. Related Sections include the following:
 - 1. Division 3, Section 03300, "Cast in-place Concrete".
 - 2. Division 15, Section 15055, "Motors".
 - 3. Division 15, Section 15990, "Testing, Adjusting and Balancing".

1.3 REFERENCES

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.1- (1998) Cast Iron Pipe Flanges & Flanged Fittings, Classes 25, 125, 150 & 250.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A48 – (Rev A, 1994) "Standard Specification for Gray Iron Castings".
 - 2. ASTM A36/A36M - (1997 Rev. A) "Standard Specification for Carbon Structural Steel".
 - 3. ASTM A108 – (1999) "Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality".
 - 4. ASTM A276 - (Rev B, 1998) "Standard Specification for Stainless Steel Bars and Shapes".
 - 5. ASTM B584 – (1998 Rev. A) – "Standard Specification for Copper Alloy Sand Castings for General Applications".
 - 6. ASTM A743/A743M - (1998) "Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion resistant, for General Application".
- C. Hydraulic Institute (HI):
 - 1. HI 1.1 – 1.5 – Centrifugal pumps for Nomenclature, Definition, Application, and Operation.
 - 2. HI 1.6 -- Centrifugal Pump Test.
- D. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. IEEE 112 – (1996 Test Method B) – Standard Test Procedure for Polyphase Induction Motors and Generators.
- E. National Fire Protection Association (NFPA):
 - 1. NFPA 70 – National Electrical Code.
- F. Underwriters Laboratories Inc. (UL):

1. UL 778 – Motor Operated Water Pumps.
2. UL 486A – (1998) Wire Connectors and Soldering Lugs for Use with Aluminum Conductors.
3. UL 486B – (1997) Wire Connectors for Use with Aluminum Conductors.

1.4 PERFORMANCE REQUIREMENTS

- A. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.5 SUBMITTALS

- A. Product Data: Include certified performance curves and rated capacities; shipping, installed, and operating weights; furnished specialties; final impeller dimensions; and accessories for each type of product indicated. Indicate pump's operating point on curves.
- B. Shop Drawings: Show pump layout and connections. Include Setting Drawings with templates for installing foundation and anchor bolts and other anchorages.
 1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
- C. Operation and Maintenance Data: For pumps to include Operation and Maintenance (O&M) manuals as specified in General and Supplementary General Conditions.

1.6 QUALITY ASSURANCE

- A. UL Compliance: Fabricate and label pumps to comply with UL 778, "Motor-Operated Water Pumps," for construction requirements.
- B. Product Options: Drawings indicate size, capacity, connections, and dimensional requirements of pumps and are based on the specific types and models indicated. Other manufacturers' pumps with equal performance characteristics may be considered. Refer to General and Supplementary Conditions section "Substitutions."
- C. Regulatory Requirements: Fabricate and test centrifugal pumps to comply with HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation," and HI 1.6, "Centrifugal Pump Tests."
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.
- B. Store pumps in dry location.
- C. Retain protective covers for flanges and protective coatings during storage.
- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with pump manufacturer's written rigging instructions.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases and inertia bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3, Section 03300, "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.1 GENERAL PUMP REQUIREMENTS

- A. Pump Units: Factory assembled and tested.
- B. Motors: Unless otherwise indicated, general motor requirements shall be according to Division 15, Section 15055, "Motors". Include built-in, thermal-overload protection and grease-lubricated ball bearings. Select each motor to be nonoverloading over full range of pump performance curve.
- C. Motor Energy Efficiency: Minimum efficiency as indicated according to IEEE 112, Test Method B. If efficiency is not indicated, provide motors with higher efficiency than "average standard industry supplied motors" and shall comply according to IEEE 112, Test Method B.
- D. Motors indicated to be operated with Variable Frequency Drives (VFD): Manufactured with insulation and other materials compatible with BFD operation.

2.2 IN-LINE CENTRIFUGAL PUMPS

- A. In-line, centrifugal, *horizontal configuration*, single-stage, bronze-fitted, radially split case design; rated for **125-psig (860-kPa)** minimum working pressure and a continuous water temperature of **225 deg F (107 deg C)**.
 - 1. Casing: Cast iron, with threaded companion flanges for piping connections, and threaded gage tapings at inlet and outlet connections.
 - 2. Impeller: ASTM B 36/B 36M, rolled-temper-brass fabrication, statically and dynamically balanced, closed, overhung, single suction, and keyed to shaft.
 - 3. Shaft and Sleeve: Steel shaft (stainless steel for TECW Service) with oil-lubricated copper sleeve.
 - 4. Seals: Mechanical type. Include carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and EPT gasket.
 - 5. Pump Bearings: Oil-lubricated, bronze journal, and thrust type.
 - 6. Motor Bearings: Oil-lubricated, sleeve type.
 - 7. Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
 - 8. Motor: Resiliently mounted to pump casing.
- B. In-line, *compact configuration*, seal-less, centrifugal, water-cooled, horizontal configuration and single stage. Include pump and motor assembled on a common shaft in hermetically sealed unit, without stuffing boxes or mechanical seals. Include lubrication of sleeve bearing and cooling of motor by circulating pumped liquid through motor section, and isolation of motor section from motor-stator windings by corrosion-resistant, nonmagnetic, alloy liner. Include design rated for **125-psig (860-kPa)** minimum working pressures and a continuous water temperature of **225 deg F (107 deg C)** maximum.
 - 1. Casing: Cast bronze or cast iron, with stainless-steel liner, static O-ring seal to separate motor section from motor stator, and flanged piping connections.
 - 2. Impeller: Overhung, single suction, closed or open, nonmetallic.
 - 3. Shaft and Sleeve: Stainless-steel shaft with carbon-steel sleeve.
 - 4. Motor: Single speed.

- C. In-line, centrifugal, *vertical configuration*, flexible-coupled, single-stage, radially split case design. Include vertical-mounting, bronze-fitted design and mechanical seals rated for **125-psig (860-kPa)** minimum working pressure and a continuous water temperature of **225 deg F (107 deg C)**.
1. Casing: Cast iron, with threaded companion flanges for piping connections smaller than **NPS 3 (DN80)**, drain plug at low point of volute, and threaded gage tappings at inlet and outlet connections.
 2. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, and keyed to shaft.
 3. Shaft and Sleeve: Ground and polished stainless-steel shaft with bronze sleeve.
 4. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
 5. Motor: Directly mounted to pump casing and with lifting and supporting lugs in top of motor enclosure.

2.3 END-SUCTION CENTRIFUGAL PUMPS

- A. Base mounted, centrifugal, ***close-coupled***, end-suction configuration, single-stage, bronze-fitted, back-pull-out, radially split case design; rated for **175-psig (1200-kPa)** minimum working pressure and a continuous water temperature of **212 deg F (100 deg C)**.
1. Casing: Cast iron, with flanged piping connections, drain plug at low point of volute, and threaded gage tappings at inlet and outlet connections.
 2. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, keyed to shaft, and secured by locking cap screw.
 3. Wear Rings: Replaceable, bronze casing ring.
 4. Shaft and Sleeve: Steel shaft extension with bronze sleeve and neoprene slinger.
 5. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
 6. Motor: Directly mounted to pump casing and with supporting legs as integral part of motor enclosure.
- B. Base-mounted, centrifugal, ***flexible-coupled***, end-suction configuration, single-stage, bronze-fitted, back-pull-out, radially split case design; rated for **175-psig (1200-kPa)** minimum working pressure and a continuous water temperature of **212 deg F (100 deg C)**.
1. Casing: Cast iron, with flanged piping connections, drain plug at low point of volute, threaded gage tappings at inlet and outlet connections, and integral feet or other means on volute to support weight of casing and attached piping. Casing shall allow removal and replacement of impeller without disconnecting piping.
 2. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, keyed to shaft, and secured by locking cap screw.
 3. Wear Rings: Replaceable, bronze casing ring.
 4. Shaft and Sleeve: Steel shaft with bronze sleeve.
 5. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
 6. Coupling: For motor sizes of 100 hp and smaller, provide flexible-spacer type coupling, capable of absorbing torsional vibration and shaft misalignment. For sizes larger than 100 hp, provide coupling with flange and sleeve section that can be disassembled and removed without removing pump or motor.
 7. Coupling Guard: Steel, removable, and attached to mounting frame.
 8. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate for mounting pump casing, coupling guard, and motor. Field-drill motor mounting holes for field-installed motors.
 9. Motor: Secured to mounting frame, with adjustable alignment.
- C. Base-mounted, centrifugal, ***flexible-coupled***, end-suction configuration, single-stage, 316 Stainless Steel construction for all wetted end components, back-pull-out, rated for 175-psig

(1200-kPa) minimum working pressure and a continuous water temperature of 212 deg F (100 deg C) maximum. Size and capacity as indicated on Target Building drawings for specific use only.

1. Casing: ASTM A743 Grade CF-8M, Investment cast, type 316 Stainless Steel, volute design for maximum efficiency. Back pullout configuration for ease of maintenance. Vertical discharge shall be standard, but field modifiable to four other positions if required. Drilled for 150 lbs. ANSI drilling flanged piping connections, drain plug at low point of volute, and integral feet or other means on volute to support weight of casing and attached piping. Casing shall allow removal and replacement of impeller without disconnecting piping.
2. Impeller: ASTM A743 Grade CF-8M, Investment cast, type 316 Stainless Steel, enclosed design for maximum efficiency and service life. Impeller shall not require clearance adjustment. Impeller shall be statically and dynamically balanced and shall be complete with key driven shaft connection and 316 Stainless Steel locknuts.
3. Shaft and Sleeve: High strength ASTM A108 SAE 1200 Series steel shaft, keyed design non-wetted. Protected from pumpage by O-ring seal and hooked design, Shaft - sleeve shall be ASTM A276, Type 316 Stainless Steel.
4. Seals: Mechanical, with standard carbon/ceramic faces, BUNA Elastomer and 316 Stainless Steel metal components.
5. Coupling: Provide flexible-spacer type coupling, capable of absorbing torsional vibration and shaft misalignment.
6. Coupling Guard: Steel, removable, and attached to mounting frame.
7. Bearing Foot: Heavy duty ASTM A48 CL 20 Cast Iron foot with grease lubricated ball bearings. Minimum B-10 average design life under normal load conditions of 8,000 hours.
8. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Secured to mounting frame, with adjustable alignment. Field-drill motor mounting holes for field-installed motors.
9. Motor: Secured to mounting frame, with adjustable alignment.

2.4 DOUBLE-SUCTION CENTRIFUGAL PUMPS

- A. Base-mounted, centrifugal, *horizontal configuration*, flexible-coupled, double-suction, single-stage, bronze-fitted, axially split case design; rated for 175-psig (1,200-kPa) minimum working pressure and a continuous water temperature of 225 deg F (107 deg C), with mechanical seals and impeller mounted between bearings.
 1. Casing: Cast iron; with ASME B16.1, Class 125 flanged pipe connections. Include threaded gage tapings at inlet and outlet connections, vent valve at high point of volute, and threaded drain plug at low point of volute.
 - a. Casing shall allow removal and replacement of impeller without disconnecting piping.
 2. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, double suction, and keyed to shaft.
 3. Wear Rings: Replaceable, bronze casing ring.
 4. Shaft and Sleeve: Stainless-steel shaft with bronze sleeve.
 5. Pump Shaft Bearings: Grease-lubricated ball bearings contained in cast-iron housing.
 6. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
 7. Coupling: Flexible-spacer type, capable of absorbing torsional vibration and shaft misalignment; with flange and sleeve section that can be disassembled and removed without removing pump or motor.
 8. Coupling Guard: Steel, removable, and attached to mounting frame.
 9. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate for mounting pump casing, coupling guard, and motor. Field-drill motor mounting holes for field-installed motors.

10. Motor: Secured to mounting frame, with adjustable alignment.
- B. Base-mounted, centrifugal, *vertical configuration*, flexible-coupled, double-suction, single-stage, bronze-fitted, axially split case design; made for vertical mounting; and rated for **175-psig (1,200-kPa)** minimum working pressure and a continuous water temperature of **212 deg F (100 deg C)**, with mechanical seals.
 1. Casing: Cast iron; with ASME B16.1, Class 125 flanged pipe connections. Include threaded gage tappings at inlet and outlet connections and threaded drain plug at low point of volute.
 2. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, double suction, mounted between bearings, and keyed to shaft.
 3. Wear Rings: Replaceable, bronze casing ring.
 4. Shaft: Stainless-steel shaft with axially split spacer coupling.
 5. Pump Shaft Bearings: Grease-lubricated, ball-type, thrust bearings contained in cast-iron housing.
 6. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
 7. Coupling: Flexible-spacer type, capable of absorbing torsional vibration and shaft misalignment; with flange and sleeve section that can be disassembled and removed without removing pump or motor.
 8. Baseplate: Steel or cast iron.
 9. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate for mounting pump casing, coupling guard, and motor. Field-drill motor mounting holes for field-installed motors.
 10. Motor: Secured to mounting frame, with adjustable alignment.

2.5 HYDRONIC SPECIALTIES

- A. *Suction Diffuser*: Angle or straight pattern, **175-psig (1,200-kPa)** pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory- or field-fabricated support.
- B. *Triple-Duty Valve*: Angle or straight pattern, **175-psig (1,200-kPa)** pressure rating, cast-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features.
- C. *Calibrated Balancing Valve*: 2 ½" – 3" shall have brass ball with glass and carbon filled TFE seat rings, 4" – 8" shall be fitted with a bronze seat, replaceable bronze disc with EPDM seal insert, and stainless steel tem. Furnished with calibrated name plate and memory stop indicator, complete with capped readout valves fitted with internal check valves 250°F (121°C) **175-psig (1,200-kPa)** pressure rating, cast-iron body.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Provide housekeeping pads under all pump assemblies.
- B. Examine equipment foundations, inertia bases, and anchor-bolt locations for compliance with requirements for installation.
 1. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

2. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Install pumps according to manufacturer's written instructions.
 1. Install pumps according to HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."
- B. Any pump location at other than the building's basement or ground level shall have both isolation and inertia pad mounts to reduce motor and pump vibration transmission into the building.
- C. Install pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.
- D. Support pumps and piping separately so piping is not supported by pumps.
- E. Suspend in-line pumps using continuous-thread hanger rod and vibration-isolation hangers. Install seismic bracing as required by authorities having jurisdiction.
- F. Set base-mounted pumps on concrete foundation of inertia base. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.
 1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of **3/4 to 1-1/2 inches (19 to 38 mm)** between pump base and foundation for grouting.
 2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.
 3. Install pump on inertia base according to manufacturer's written instructions.

3.3 ALIGNMENT

- A. Align pump and motor shafts and piping connections after setting them on foundations, after grout has been set and foundation bolts have been tightened, and after piping connections have been made.
- B. Comply with pump and coupling manufacturers' written instructions.
- C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Install piping adjacent to machine to allow service and maintenance. Connect piping to pumps. Install valves that are the same size as piping connected to pumps.

- B. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- C. Install swing check valve and ball valve on discharge side of sump pumps.
- D. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- E. Install pressure gages on pump suction and discharge. Install at integral pressure-gage tapings where provided.
- F. Install electrical connections for power, controls, and devices.
- G. Electrical power and control wiring and connections are specified in Division 16 Sections.
- H. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 COMMISSIONING

- A. Verify that pumps are installed and connected according to the Contract Documents.
- B. Verify that electrical wiring installation complies with manufacturer's written instructions and the Contract Documents.
- C. Perform the following preventive maintenance operations and checks before starting:
 - 1. Lubricate bearings.
 - 2. Remove grease-lubricated bearing covers, flush bearings with kerosene, and clean thoroughly. Fill with new lubricant according to manufacturer's written instructions.
 - 3. Disconnect coupling and check motor for proper rotation that matches direction marked on pump casing.
 - 4. Verify that pumps are free to rotate by hand and that pumps for handling hot liquids are free to rotate with pumps hot and cold. Do not operate pumps if they are bound or drag, until cause of trouble is determined and corrected.
 - 5. Check suction piping connections for tightness to avoid drawing air into pumps.
 - 6. Clean strainers.
 - 7. Verify that pump controls are correct for required application.
- D. Starting procedure for pumps with shutoff power not exceeding safe motor power is as follows:
 - 1. Prime pumps by opening suction valves and closing drains, and prepare pumps for operation.
 - 2. Open cooling water-supply valves in cooling water supply to bearings, where applicable.
 - 3. Open cooling water supply valves if stuffing boxes are water-cooled.
 - 4. Open sealing liquid-supply valves if pumps are so fitted.
 - 5. Open warm-up valves of pumps handling hot liquids if pumps are not normally kept at operating temperature.
 - 6. Open circulating line valves if pumps should not be operated against dead shutoff.
 - 7. Start motors.
 - 8. Open discharge valves slowly.
 - 9. Observe leakage from stuffing boxes and adjust sealing liquid valve for proper flow to ensure lubrication of packing. Let packing "run in" before reducing leakage through stuffing boxes; then tighten glands.

10. Check general mechanical operation of pumps and motors. Close circulating line valves once there is sufficient flow through pumps to prevent overheating.
- E. When pumps are to be started against closed check valves with discharge shutoff valves open, steps are the same, except open discharge valves before starting motors.
- F. Refer to Section 15990 "Testing, and Balancing" for detailed requirements for testing, adjusting, and balancing hydronic systems.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train CM designated operating and maintenance personnel to adjust, operate, and maintain hydronic pumps as specified below:
 1. Train maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining pumps.
 2. Review data in Operation and Maintenance (O&M) manuals.
 3. Schedule training with Construction Manager with at least seven days' advance notice.

END OF SECTION 15185